

**KEY TO THE NEARCTIC SPECIES OF PIESMIDÆ
(HETEROPTERA).**

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Hitherto the family Piesmidæ has been supposed to be represented in North America by only a single species, *Piesma cinerea* Say. To the writer this has appeared an improbable state of affairs, especially in view of the fact that twelve or more palæarctic species are recognized. His desire to study the nearctic representation of the family has been gratified chiefly because of much appreciated loans of material by the following hemipterists: E. D. Ball, H. G. Barber, Carl J. Drake, Edmund H. Gibson, J. R. Malloch, Herbert Osborn and, H. M. Parshley, to all of whom he returns sincere thanks.

As stated, but one species of *Piesma* has hitherto been recognized from the nearctic region; in this paper eight new species and two new varieties are described, and one previously described species, *Agrammodes costatus* Uhler, assigned here. The new species are all from southwestern states where careful collecting of the group should be done. The Piesmidæ are partial to plants of the family Chenopodiaceæ, which when systematically examined in this country, will yield an abundance of specimens of some of the new species herein described, and probably additional new species. In connection with the present study examples of most of the European species have been examined, and there seem to be no holarctic identities. It may be added that the palæarctic species average smaller than the nearctic.

The Piesmidæ when recognized as a family distinct from the Tingidæ has been based on characters most of which are not absolutely trenchant.

The opposed characters are stated in the subjoined parallel columns:

PIESMIDÆ.

TINGIDÆ.

Jugæ free and more or less produced at apex.	Jugæ scarcely produced.
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Scutellum exposed.	Scutellum usually concealed.
Discoidal area of elytra divided by a longitudinal vein.	Discoidal area not divided.
Ocelli usually present in macropterous forms.	Ocelli absent.
Clavus distinct in macropterous forms.	Clavus usually lacking or united with corium.
Membrane distinct, coriaceous only at base in macropterous forms.	Membrane entirely coriaceous and reticulated.

Characters which exist only in macropterous individuals are not satisfactory for definition of a family which contains numerous species often or usually brachypterous. Thus the last three characters listed in the foregoing table, though often used, are inadequate. Of the first three characters two are not entirely unequivocal, leaving really functional but one of the six characters usually advanced for recognition of the Piesmidæ. The division of the discoidal area by a longitudinal vein, the cubital, is seen in both long- and short-winged Piesmidæ, but not at all in Tingidæ. This together with sole possession of the peculiar thoracic cavities described below render it expedient to continue recognition as a distinct family of this group so intermediate between Lygaeids and Tingids that it has in turn been united with each.

The family Piesmidæ includes so far as known only the single genus *Piesma*, genotype *Acanthia capitata* Wolff.

Synonymy of the genus is as follows:

Piesma Saint-Fargeau et Serville. Encyclopédie Méthodique, Histoire Naturelle, Tom. X, Part. 2 (1825), 1828, p. 653. (*Acanthia capitata* Wolff and *Tingis quadricornis* Dufour.)

Zosmenus Laporte, F. L. de. Essai d'une Classification Systématique de l'Ordre des Hémiptères (Hémiptères Hétéroptères, Latr.) Magasin Zoologique (Guérin), 1832, p. 49 (*Zosmenus maculatus* n. sp.). *Zosnanus* on p. 47.

Aspidotoma Curtis, John. Characters of some undescribed Genera and species indicated in the "Guide to an arrangement

of British Insects." The Entomological Magazine, January, 1833, pp. 196-197. (Type *Acanthia capitata* Wolff.)

Zosmerus Burmeister, Hermann. Handbuch der Entomologie, Bd. II, Abth. 1, 1835, p. 262. (*Acanthia capitata* Wolff and *Zosmenus maculatus* Laporte.)

Agrammodes Uhler, P. R. in A Preliminary List of the Hemiptera of Colorado, by C. P. Gillette and Carl F. Baker, Bul. 31, Colo. Agr. Exp. Sta. (May, 1895), June 7, 1895, p. 56. (*Agrammodes costatus* n. sp.)

From examination of the type of *Agrammodes costatus* Uhler and numerous other specimens I have no doubt that the species is a brachypterous *Piesma*. It possesses all essential characters of the genus including the divided discoidal area and peculiar thoracic cavities described further on; Uhler himself mentions "the characteristic head of *Piesma*."

Uhler compares his species to *Agramma* and if we may judge from his selection of a generic name was much impressed by the similarities. Van Duzee places* Uhler's genus and species in the Serenthiini, the tribe of the Tingidæ to which *Agramma* = *Serenthia* belongs. However one of the principal characters of that tribe is that the lateral margins of the pronotum are never laminate-dilated. In the type specimen of *Agrammodes costatus* this margin is explanate, a fact indicated in Uhler's description by the expression "lateral margins a little reflexed."

The more important structural characters of the genus *Piesma* are the following: *Antenna*: first joint globular to ovoid; second ovoid, shorter than first; third cylindrical, slightly enlarged distally, usually the longest joint and at least as long as fourth; the latter clavate, finely pubescent. *Head*, with the jugæ produced as slender processes, projecting more or less beyond tylus, and more or less connivent before it; ocelli usually distinct in macropterous specimens; a double spine at the inner angle of each eye; beak extending slightly beyond fore coxæ, first joint alone, and second and third together, a little shorter than fourth.

Rostral sulcus deep on head, the bucculæ high, thin and incurved, deep also on forepart of prosternum, narrower and

* Van Duzee, E. P. Catalogue of the Hemiptera of America North of Mexico, etc. Univ. of Calif. Publ. Tech. Bul., Vol. 2, Nov. 30, 1917, p. 223.

shallow between fore-coxæ, represented by two lines of pollinosity on mesosternum and by a broad and shallow depression of metasternum.

Thorax beneath, coarsely reticulated except for mesosternum which is finely granular and dark colored, even black, on each side of rostral sulcus. Thorax above, coarsely punctate, more or less narrowed anteriorly, humeral regions rather prominent, anterior lateral margins distinctly, though narrowly, explanate, usually sinuate and slightly reflexed; thorax with five more or less evident carinæ, the lateral pair sometimes being mere bullæ near anterior angles; the central group of three, of which the outer two are the strongest, are often conspicuous, and sometimes tortuous and more or less calloused; these carinæ become evanescent on posterior lobe of thorax, the small central one is sometimes obsolete, and all may be inconspicuous; the other two carinæ, referred to in a preceding sentence as the lateral pair, do not vary so much in development, though in a few cases they become prolonged posteriorly, forming veritable carinæ parallel-ling and resembling the central pair; these lateral carinæ are important however as they share in a character which appears to be the most remarkable of any possessed by this group, they being hollowed out beneath, housing a cavity, having a lunate opening on the underside of thorax just within the anterior portion of expanded thoracic margin, the inner side of which cavity is convex and smooth, the outer concave with the coarse reticulation of the upper surface of the thorax showing through; internally the inner wall of this cavity is the seat of attachment of a very large muscle mass. This peculiar cavity evidently is a fundamental character, as it has been found in all the species and in nymphs of all stages examined. It does not seem to be present in any of the genera of the Tingidæ, and of all the characters assigned would seem to afford the most firm ground for recognition of the family Piesmidæ.

Scutellum: large, granular, exposed near apex in a rounded, calloused tubercle.

Elytra, in macropterous specimens: coarsely punctate, excepting membrane; clavus distinct; elytra without discal area as in Tingids, this part of elytron being divided by the prominent

cubital vein; distad of posterior extension of brachial vein, the membrane is bordered by a narrow reticulate area; membrane with four spur veins, only one of which, the third from apex, appears to be a direct continuation of one of the other elytral veins (the cubital).

Elytra, in brachypterous specimens, everywhere coarsely punctate, the claval suture obliterated and claval area solidly fused with remainder of elytron; the claval vein and upper part of brachial vein join, enclosing a distinct area additional to those observable in the macropterous elytron. Because of the absence of a membrane, the longitudinal veins are lengthened; furthermore all the veins are more prominent than in macropterous specimens. For descriptive purposes, names of the elytral areas have been needed and those adopted are indicated in one of the accompanying figures.

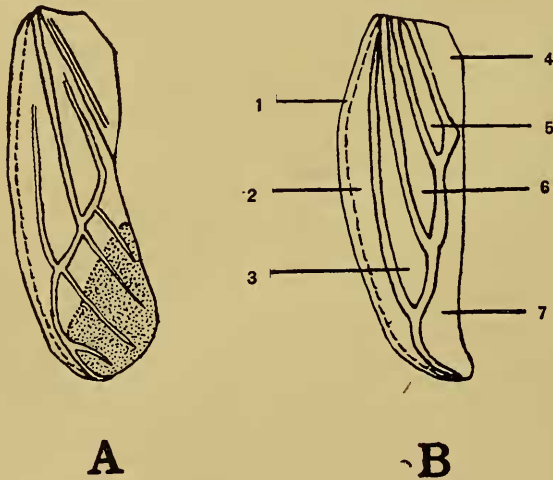


FIG. 1.—*A*, macropterous elytron of *Piesma*, membrane stippled; *B*, brachypterous elytron of *Piesma*, elytral areas are named as follows: 1, costal; 2, subcostal; 3, cubital; 4, claval; 5, interstitial; 6, brachial, and 7, sutural.

Venter: fifth abdominal segment narrowed in middle, fifth and sixth each terminating at their postero-lateral angles in

rounded tubercles; male genital segment broadly rounded, a notch between it and posterior edge of sixth segment, another notch on edge of sixth segment just inside tubercle. In females the sixth segment is almost completely divided by a triangular notch for the reception of the genital segment, which is acute posteriorly; there are two triangular processes on each side between apex of genital segment and tubercle of sixth segment, the inner larger and belonging to the genital segment, the outer smaller, rounded, belonging to the sixth segment and scarcely extending caudad of tubercle.

KEY TO THE SPECIES.

- A. Thorax more or less emarginate on each side.
 - B. Thorax distinctly narrower across anterior than across posterior angles ($\frac{1}{6}$ to $\frac{1}{5}$ less).
 - C. Posterior lobe and humeral region of thorax rather swollen; dorsal carinæ inconspicuous; third antennal joint in proportion to fourth as 8 is to 7; reticulated area distad of posterior arm of brachial vein (and bordering membrane), with a distinctly scalloped margin, decurrent farthest along third membranal vein (extension of cubitus).....*patruela* n. sp.
 - CC. Posterior lobe of thorax not unusually elevated; dorsal carinæ distinct; third antennal joint long both absolutely, and relative to fourth joint, proportions 8-10:6-7; reticulated area distad of posterior arm of brachial vein of nearly uniform width where traversed by second to fourth membranal veins, the edge nearly straight.....*cinerea* Say.
 - BB. Thorax nearly as wide across anterior as across posterior angles ($\frac{1}{15}$ to $\frac{1}{12}$ less); third joint of antenna short, both absolutely, and relative to fourth joint, proportions 6-7:5-6.
 - D. Dorsal carinæ of thorax very distinct, elevated, more or less tortuous; an intercalated carina behind each callosity being more or less evident.
 - E. Brachial area distinctly larger than cubital, the latter with not more than three series of punctures,

brachialis n. sp.
 - EE. Brachial area not larger than cubital, the latter with four or more series of punctures.
 - F. More closely punctured, number of punctures along inner apical border of cubital area 7-8,

ceramica n. sp.

- FF. Less closely punctured, number of punctures along inner apical border of cubital area 5,
rugulosa n. sp.
- DD. Dorsal carinæ less distinct, not at all tortuous, sometimes nearly obsolete.
- G. Maximum number of series of punctures in subcostal area 3.
- H. Clavus or claval area with about 4 series of punctures; color uniform fuscous.....*protea* n. sp.
- HH. Clavus or claval area with about 3 series of punctures; typical color stramineous with conspicuously darkened veins*costata* Uhler.
- GG. Maximum number of series of punctures in subcostal area 4-5.
- I. Form more depressed, subcostal area less deflexed; color brown.....*depressa* n. sp.
- II. Form thicker, subcostal area very convex and deflexed; front margin of pronotum nearly or quite angularly emarginate; color pale....*incisa* n. sp.
- AA. Thorax without lateral emarginations; paranota unusually broad, with two full series and some intercalated areoles.....*explanata* n. sp.

Piesma patruela, n. sp.

A species recognizable by the swollen posterior lobe, prominent humeral region and narrowed front of thorax, together with the reticulated area between posterior extension of brachial vein and membrane being distinctly scalloped in outline and decurrent farthest on extension of cubital vein. The carinæ of the thorax are merely low rounded swellings and the posterior prolongations of the paranota are evanescent before reaching humeral angles. Areolar formula, see table, page 92. Length 2.25 mm.

The ground color is pale ivory, with the callosities, and head except processes, black; scutellum, streaks on thorax, and spots on all parts of elytron except base of corium and membrane, dark brown; under surface chiefly dark brown. In color and form of thorax this insect suggests *Leptoypa mutica* Say.

Type, a male, labelled Arizona, Morrison, 1882 (U. S. N. M.). Paratype, a male, from Cotulla, Texas, April 15, 1906, F. C. Pratt (U. S. N. M.).

Piesma cinerea Say.

T. [ingis] cinerea Say, Thomas. Descriptions of new species

of Heteropterous Hemiptera of North America, 1832, p. 26; The Complete Writings of Thomas Say on the Entomology of North America, 1, 1859, p. 349. [United States.]

The more valuable recognition characters of this species are: Thorax distinctly narrower in front than behind, thoracic carinæ strong, usually slightly tortuous and calloused, the smaller median carina usually evident; third antennal joint long, distinctly longer than fourth; reticulated area between posterior extension of brachial vein and membrane, of nearly uniform width where transversed by second and fourth membranal veins, the edge usually almost straight. Areolar formula; see table, page 92. Length 2.75-3.25 mm.

Apparently *P. cinerea* remains a transcontinental species. This is not to say that there is not a considerable degree of variation, but that it is not distinctly correlated with geographic distribution or is otherwise unavailable for taxonomic purposes. A few specimens examined had the paranota almost bisinuate and somewhat reflexed, but I am convinced this is mere individual variation. There are faint indications that a western subspecies is forming; specimens from California in particular seem to average larger, paler in color and have the third antennal joint slightly shorter. These differences are not marked however and I am not inclined to recognize them by naming the variants.

The coloration is variable, the usual pattern being a pale stramineous ground bearing mostly irregular brownish blotches, largest and sometimes solidly occupying considerable areas on posterior lobe of thorax. On costal margin 6-7 spots tend to have a more regular oblong form. On the anterior lobe of the thorax outside of carinæ and just anterior to transverse impression are two approximately round brown patches covering the callosities. The ground color varies to dead white and rufescent and the markings from light-brown to black.

The color varieties grade into each other to such an extent that it is probably not worth while to name all of them. I have separated under vernacular name only, pale, spotted and dark varieties. One other variety which is distinct and always separable, I name *Piesma cinerea* var. *inornata* new variety. It varies from pale stramineous to greenish in color, and is entirely with-

out dark markings, even the callosities being pale. Type, a male, from Lindsay, California, August 29, 1911, on tumbleweed, J. R. Horton (U. S. N. M.).

On the basis of specimens examined *P. cinerea* as a whole ranges from Washington State, Ontario and Massachusetts south to California, Texas, Florida, and to Linares and Tampico, Mexico. Variety *inornata* apparently may occur anywhere in the general range.

Piesma brachialis, n. sp.

Thorax nearly as wide in front as behind; carinæ distinct and tortuous; third antennal joint but little longer than fourth; brachial area distinctly larger than cubital.

Structural details as noted in key; ground color pale stramineous, reticulation more brownish, with last joint of antenna (except at base), tip of clavus, tip of beak, and mesosternum except along middle, blackish brown; corium near humeral angle pale and slightly calloused; eyes reddish. Thoracic carinæ distinct, the outer ones of the central group abruptly convergent near front margin of thorax, slightly divergent posteriorly. Brachial area of elytron larger than cubital the latter with a maximum of three series of punctures. Areolar formula, see table, page 92. Length 2.75 mm.

Type of male from Tucson, Ariz., December 20, H. G. Hubbard (U. S. N. M.). The type and the paratype described below were found on *Isocoma (Bigelovia) hartwegi*, according to a letter from Mr. Hubbard, kindly extracted for me by Mr. E. A. Schwarz. On account of the specimens being collected at the same time, on the same plant, and particularly because they agree in having the brachial area distinctly larger than the cubital, I have no doubt that the macropterous type and brachypterous paratype belong to the same species. The paratype is a broadly oval brachypterous form, more than half as broad as long; reticulation coarse, claval area with only three rows of punctures, brachial area decidedly larger than cubital, the latter with a maximum of three rows of punctures. A few faint brown flecks on costa; eyes, terminal antennal joints, and tip of beak dark reddish brown. Length 2.5 mm.

Another paratype, also a brachypterous female from Richfield, Utah, August 24 (Ball), is a little more robust, and has tips of the clavi, about six maculæ on either costa, and scattered dots on the principal veins and on thorax, black.

***Piesma ceramica*, n. sp.**

Thorax and antenna as indicated in key; thoracic carinæ very distinct, more or less tortuous, the pair of lateral carinæ especially being longer and more conspicuous than in preceding forms; a pair of intercalated short carinæ just back of callosities.

A brachypterous species, pale stramineous in color, with only traces of light brown spots along costal margins and on callosities, eyes reddish. Elytra slightly surpassing abdomen, the divisions solidly fused, sometimes slightly incurved and overlapping at tip, sometimes not. Whole dorsal surface closely punctate; the distinct sculpturing and pale color suggest a wax counterfeit fresh from the mould, rather than a real insect. Areolar formula, see table, page —. Length 3 mm.

Described from three females, labelled Courthouse, U., 8-10-06 (U. S. N. M.).

***Piesma rugulosa*, n. sp.**

A species much like the above in structure of antennæ and thorax including the carinæ, but smaller, less closely punctured, and spotted.

Elytra distinctly brown spotted; about nine spots on each costal margin, scattered spots on corium and claval area of the fused elytron, and a few indistinct spots on posterior part of thorax; venter with five series of brown spots; eyes pale. Areolar formula, see table, page 92. Length 2.5 mm.

Type a brachypterous male, from Rocky Ford, Colo., April 18, 1911, on greasewood, H. O. Marsh (U. S. N. M.).

***Piesma protea*, n. sp.**

Structure of antenna and thorax as noted in key; carinæ much reduced, the median pair only being obvious, lateral almost obsolete, central and intercalated lacking.

Color pale stramineous to pale fuscous, the membranous por-

tions of integument whitish hyaline, jugæ and other processes of head (except sometimes chiefly fuscous basal and terminal joints of antennæ) concolorous or ivory color. Venter with two median series of large and two lateral series of small pale yellow spots; or entirely pale. Areolar formula, see table, page 92. Length 2.25–2.5 mm.

Type, a macropterous male, from Hot Springs, Arizona, June 21, H. S. Barber (U. S. N. M.).

Paratypes, a brachypterous male, labelled Arizona, Morrison, 1882 (U. S. N. M.), and one brachypterous and one macropterous male from Lincoln, Nebraska. July. (Drake.)

Piesma costata Uhler.

Agrammodes costatus Uhler, P. R. new genus and species in A Preliminary list of the Hemiptera of Colorado, by C. P. Gillette and C. F. Baker, Bul. 31, Colo. Agr. Exp. Sta. (May, 1895), June 7, 1895, pp. 56–7 [Estes Park, Colo.].

Reasons for synonymizing the genus *Agrammodes* with *Piesma* have been discussed in the introduction.

The species *costata* is characterized by the structural details pointed out in the key, and especially by the thoracic carinæ being obsolete and the veins of the elytra very prominent and dark.

Ground color pale stramineous or whitish, least obscured on anterior lobe and margins of thorax and base of corium, the latter always occupied by a pale spot. Reticulation of most of upper surface of varying shades of fuscous, the principal veins of elytra infuscate, elevated and conspicuous. Callosities, scutellum, humeral angles and head except processes fuscous to blackish, processes of head and antennæ except apical half of terminal joint, honey yellow. The jugæ vary greatly in length; in females they are sometimes no longer than tylus, in males they sometimes reach to middle of second antennal joint. Areolar formula, see table, page 92. Length 2–2.25 mm.

Specimens examined:

A specimen from collection of E. D. Ball, labelled Colo. No. 1133, is marked type. The full data for the type as given by

Gillette and Baker is Estes Park, Colo., July 12, Gillette; Fort Collins, Colo., June 1, 16; July 1, 28, 1898 (Drake, Barber, McAtee); N. Colo., 5.9.98 (Ball); Arizona (U. S. N. M.).

A specimen from Fort Collins, Colo., July 1, 1898 (Drake), with whole body except eyes, terminal antennal joint and tip of beak stramineous, is made the type of *Piesma costata* variety *defecta* new variety.

***Piesma depressa*, n. sp.**

Structure of antenna and thorax as indicated in key: carinæ, except intercalary traceable, but low, front of thorax almost angularly emarginate; whole dorsal surface closely punctate, sutural area with a maximum of six rows of punctures.

Ground color stramineous, but reticulation almost uniformly infusate a little lighter at base of corium and on pronotal carinæ; apex of scutellum pale. A finely reticulated, very plainly colored species; eyes reddish. Maculations of under surface obscure. Areolar formula, see table, page 92. Length 2.25 mm.

Described from a single female specimen, labelled Ariz., 2073 (U. S. N. M.).

***Piesma incisa*, n. sp.**

Structure of antenna and thorax as pointed out in key; front of thorax almost or quite angularly emarginate; dorsal surface less closely punctate than in *P. depressa*, sutural area with a maximum of four series of punctures.

Color pale stramineous, all of basal, and apical half of terminal antennal joint, tips of jugæ, and sometimes other parts of head, and femora, infusate; eyes reddish. A closely reticulated, very pale form. Areolar formula, see table, page 92. Length 2.25 mm.

Type, a macropterous female, labelled Ariz. 2073 (U. S. N. M.).

Paratypes, brachypterous females, labelled Ariz. (Drake), and Dixie, Utah, September 9, 1915, E. D. Ball (Ball).

***Piesma explanata*, n. sp.**

In size, color and character of pronotal carinæ, this species is much like *P. cinerea* Say, but is strongly distinguished from that

and all the other species here treated, by the much broader, scarcely reflexed or sinuate paranota, in which there are two full series and some intercalated areoles. The color is stramineous, varying to reddish brown over the more opaque parts of the body; tip of clavus dark; faint fuscous maculations on paranota along costa and more sparingly elsewhere; scutellum yellowish; eyes reddish. Under surface reddish stramineous, save mesosternum which with the exception of the rostral sulcus is black; apex of beak also black. Areolar formula, see table this page. Length 3 mm.

Type a macropterous female from Mouth of Bear River, Utah, September 30, 1914, Alex. Wetmore (U. S. N. M.).

AREOLAR FORMULÆ.

As a check upon identifications, a table is subjoined showing the maximum number of series of punctures or areoles in the various elytral divisions. The maximum number of series can be counted in the various areas at about the following locations; for the subcostal area, a little anterior of middle; cubital, along a posteriorly directed oblique line from inner angle; brachial, on a line from apex of clavus through inner angle of the area; claval, opposite apex of scutellum; and sutural, an oblique series usually beginning at juncture of subcostal and cubital areas. The costal area has uniformly a single series of areoles in all species; the

TABLE OF AREOLAR FORMULÆ

Name of Species.	Area of Elytron.							Length of Wing.
	Costal.	Sub-costal.	Cubital.	Brachial.	Inter-stitial.	Claval.	Sutural.	
<i>brachialis</i> ...	I	3	4	4	2	4	2	macropterous.
	I	3	3	4	3	3	4	brachypterous.
<i>ceramica</i> ...	I	3-4	5-6	4-5	2-3	4-5	4-5	brachypterous.
<i>rugulosa</i> ...	I	3	4	4	2	4	4	brachypterous.
<i>prolea</i>	I	4	4-5	4	2	4-5	3	macropterous.
	I	3	4	4	2	4	4	brachypterous.
<i>costata</i>	I	3-4	4-5	4-5	2-3	3-4	4-5	brachypterous.
<i>depressa</i> ...	I	4	5	5	2	5	6	brachypterous.
<i>incisa</i>	I	5	5	4	2	5	3	macropterous.
	I	5	5	5	2	5	4	brachypterous.
<i>explanata</i> ...	I	5	6	4	2	5	4	macropterous.
<i>cinerea</i>	I	3-5	4-5	3-5	2	4-5	2-3	macropterous.
<i>patruela</i> ...	I	3	4	4	2	4	4	macropterous.

interstitial area varies in areolar count only in brachypterous specimens; the analogue of this area in macropterous specimens, has invariably a single row of areoles on each side of the claval suture; the count of areoles for the sutural area of macropterous specimens refers to the series of areoles in reticulated area between posterior extension of brachial vein and membrane.

REMARKS ON THE ORIGIN AND SIGNIFICANCE OF METAMORPHOSIS AMONG INSECTS,

BY G. C. CRAMPTON, PH.D.

(Continued from p. 40.)

In several publications (notably in his book "Die fossilen Insekten"), Handlirsch has developed the idea that cold is the initiating factor in the production of holometabolism. One of the reasons he proposes for so thinking is that under present climatic conditions, insects with incomplete metamorphosis flourish in mild, frost-free and tropical regions; while he seeks to give the impression that insects with complete metamorphosis occur largely in cold climates. Orthoptera, Phasmidæ, Mantidæ and Embiidæ are wholly absent from the arctic regions, while a large number of Lepidoptera, Diptera and Hymenoptera, etc., occur in the cold climates. Of such insects with incomplete metamorphosis as occur in climates with cold winters, most are not peculiar to those climates, but occur in warm climates as well, and have gradually adapted themselves to the colder climates as migrants from the warmer zones. On the other hand, many species of holometabolous insects are peculiar to the colder climates in which they occur. He points out that of all known species of Dermaptera, only about 4 per cent. occur in temperate regions with well marked winters, 2 per cent. of the Blattidæ, and a much smaller percentage of the Mantidæ, Phasmidæ, etc. On the other hand, about 30 per cent. of the species of Coleoptera, 40 per cent. of the Hymenoptera and 50 per cent. of the Diptera occur in temperate regions. In the Carboniferous